Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, JANUARY 2017

Course Code**: CH205**

Course Name**: FLUID AND PARTICLE MECHANICS – I (CH)**

Max. Marks: 100 Duration: 3 Hours

PART A

Answer *ANY TWO* questions (15 marks each)

1) a. A single column of water flowing out from a tap tends to split into smaller diameter columns. With the help of equations, state the cause for the same? (5)

b. Describe rheological classification of fluids based on stress-strain relationship with examples. (5)

c. A vertical cylinder of 90 mm diameter rotates concentrically inside a fixed cylinder of diameter 100 mm. Both cylinders are 200 mm long. Find the viscosity of the liquid that fills the space between the cylinders if a torque of 0.60 Nm is required to maintain a speed of 60 rpm. (5)

2) a. Does viscosity and density of fluids change with respect to temperature and pressure? Explain the specific reason for such behaviour. (5)

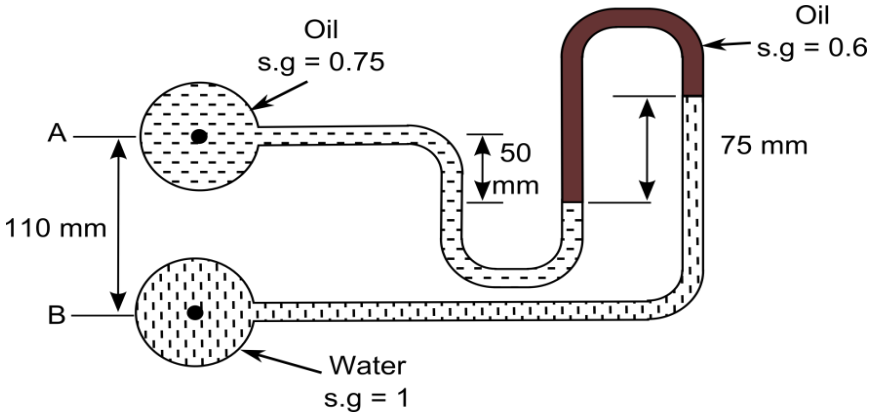
b. Demonstrate the application of Pascal's law with the working of a hydraulic jack. (5)

c. A cylindrical wooden pole of radius 40 mm and length 4 m hangs vertically from a vertical string so that 2.5 m length of the pole is submerged in water. Find the tension in the string if the specific gravity of the wood pole is 0.7. (5)

3) a. State and derive Pascal's principle of transmission of fluid pressure. What are the assumptions used in the derivation? (5)

b. What is meant by centre of buoyancy? (3)

c. Find the pressure difference between the points A & B in the figure below. (7)



PART B

Answer *ANY TWO* questions (15 marks each)

4) a. With schematic representation, explain stream line, path line, streak line, and stream tube in fluid flow. (5)

b. State the significance of kinetic energy correction factor and derive an equation for the same. (5)

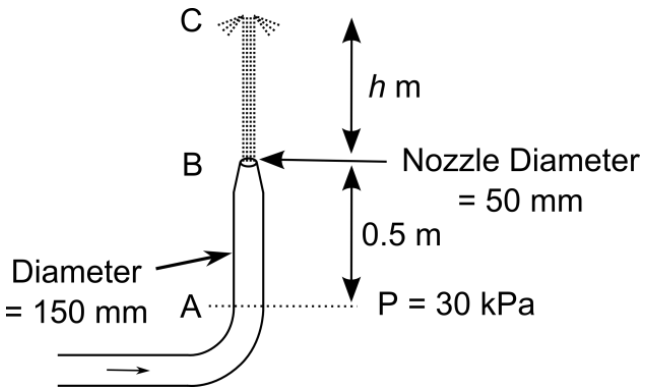
c. Consider 2 bodies of the shapes shown in the following figure obstructing the flow of a fluid stream. Sketch the possible stream lines around the body, represent boundary layer separation and wake formation. From the illustration, predict which among the two shapes would result in a higher loss of overall head of the flowing fluid.

(5)

5) a. Discuss Reynold's experiment. With suitable sketches, explain the major conclusions from his experiment. (5)

b. Turbulence in flow results in higher loss of energy compared to that in laminar flow. Do you agree to this statement? Why? (4)

c. Find the height 'h' to which the water jet will shoot out of the nozzle in the arrangement shown in the figure below. Neglect any losses.



(6)

6) a. Derive Euler's equation. (12)

b. In the Bernoulli's equation, the correction terms for pump work and fluid friction are added on either side of the equation. Why? (3)

PART C

Answer *ANY TWO* questions (20 marks each)

7) a. Derive Hagen-Poiseuille equation. (4)

b. Compare the velocity profiles of laminar and turbulent flow in a straight tube. (3)

c. An industrial grade solvent with specific gravity of 1.2 and viscosity of 15 poise is required to be pumped into an extraction column. The height of the outlet in the column is 7 m above the solvent level in the storage tank and the pump used for the operation has 70% efficiency. A flow rate of 1200 litres/minute is to be achieved through a pipe of 160 mm diameter. The total length of the pipe is 30 m. Calculate the power of the pump required for the purpose. (Note: Kinetic energy correction factor = 2 for laminar flow and 1 for turbulent flow) (8)

d. Explain the working of a rotameter with a diagram. (5)

8) a. State Prandtl one seventh power law. (3)

b. What is friction factor chart? Explain its significance. (4)

c. During the calibration of a right angled triangular notch, it was noted that 60 litres of water was collected within 1 minute. If the head of the still was 60 mm, calculate the coefficient of discharge of the notch. (5)

d. Air flows through a horizontal section of pipe having a sudden expansion from 100 mm diameter to 190 mm diameter with a flow rate of 0.1 m^3/s. Find the pressure difference between the two sections of the pipe. (density of air = 1.23 kg/m^3) (8)

9) a. Establish the shear stress distribution for laminar flow in fluid flowing through a straight pipe. Draw the profile for the same. (4)

b. What are the different valves used for regulating fluid flow? Provide the schematic diagram for any 2 type of valves. (3)

c. What is the basic principle behind the working of a pitot tube? Derive the equation for calculating fluid flow rate using a pitot tube. (6)

d. Crude oil with kinematic viscosity of 9.7 cSt and specific weight 8.8 N/m^3 is flowing through a horizontal circular pipe of diameter 100 mm and length 10 m. If 550 N of the oil is collected into the storage container in 2 minutes, find the pressure difference between the two ends of the pipe. (7)

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